Inspiratory muscle training compared with other rehabilitation interventions in chronic obstructive pulmonary disease: a systematic review update

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CRD summary
This review concluded that inspiratory muscle training plus exercise may lead to significant improvements in inspiratory muscle strength and one outcome of exercise tolerance for individuals with chronic obstructive pulmonary disease. The authors’ cautious conclusions reflected the evidence, but the variable quality of this evidence and small sample sizes and uncertain study variability should be borne in mind.

Authors' objectives
To determine the effect of inspiratory muscle training and other rehabilitation interventions among adults with chronic obstructive pulmonary disease (COPD).

Searching
Electronic databases were searched for English-language studies to December 2005; no details of the databases searched were provided. These searches updated those reported by Crowe et al. (2005). Reference lists from appropriate articles were handsearched for additional studies.

Study selection
Randomised controlled trials (RCTs) that compared inspiratory muscle training or combined inspiratory muscle training and exercise/pulmonary rehabilitation with other rehabilitation interventions among adults (at least 18 years) with COPD were eligible for inclusion. Eligible inspiratory muscle training interventions improved strength and/or endurance of inspiratory muscles. Eligible rehabilitation interventions included upper or lower extremity strength or aerobic training exercise and/or pulmonary rehabilitation (exercise training for at least four weeks either with or without education or psychological support), education (patient teaching that included the pathophysiology of COPD as well as management strategies) or other breathing techniques (any technique or exercise other than inspiratory muscle training).

Outcomes assessed were inspiratory muscle strength and/or endurance, exercise tolerance, pulmonary function testing, quality of life and dyspnoea. Mean patient age in most studies ranged from 56 to 72. COPD moderately or severely affected patients in nearly all studies. Most studies comprised more female participants than male. In all studies the forced expiratory volume (FEV$_1$) in one second was less than 65% predicted or less than 1.3 litres; in more than half of the studies the ratio of FEV$_1$ to forced vital capacity (FVC) was less than 0.7.

Two reviewers independently selected studies for inclusion in the review. Disagreements were resolved by a third reviewer.

Assessment of study quality
Methodological quality was assessed using the Jadad scale of randomisation, blinding, intention-to-treat, withdrawals, drop-outs and similarity between groups of participants.

The authors did not state how many reviewers performed the validity assessment.

Data extraction
Two reviewers extracted data to calculate weighted mean differences (WMD) and 95% confidence intervals (CIs) for continuous outcomes. Authors were contacted for additional data where necessary. Discrepancies or uncertainties related to the data extraction process were resolved by a third reviewer.

Methods of synthesis
A random-effects model was used to pool weighted mean differences and 95% CI where studies were deemed to be similar in terms of participants, modes of inspiratory muscle training, training protocols and outcome measurements. Heterogeneity was reportedly assessed, but neither method nor results were reported. Subgroup analysis was used to explore the impact of inspiratory muscle training with exercise and combined inspiratory muscle training and exercise with exercise alone. Where meta-analysis was not possible a narrative synthesis was undertaken.

**Results of the review**

Eighteen studies (n=656, range 12 to 130) were included in the review. Thirteen studies performed intention-to-treat analysis. Four studies reported no withdrawals; withdrawal rates in the other studies were between 7% and 59%. None of the studies were double-blind.

**Combined inspiratory muscle training and exercise compared with exercise alone:** Compared with exercise alone, participants in the combined inspiratory muscle training and exercise group showed a significant improvement in maximal inspiratory muscle strength (WMD 8.60cmH\(_2\)0, 95% CI 2.55 to 14.65; two studies) and maximum exercise tidal volume (WMD 0.14L, 95% CI 0.08 to 0.19; three studies). Participants in the exercise alone group showed significant improvements in the Chronic Respiratory Questionnaire dyspnoea domain (WMD -1.94, 95% CI -2.88 to -1.01; two studies) compared with those in the combined inspiratory muscle training and exercise group.

**Inspiratory muscle training compared with exercise alone:** There was no significant difference for either inspiratory muscle strength or for exercise tolerance outcomes.

Results from meta-analyses that assessed outcomes for inspiratory muscle training alone compared with exercise did not show statistically significant differences in inspiratory muscle strength and tolerance.

**Authors’ conclusions**

Performing a combination of inspiratory muscle training plus exercise may lead to significant improvements in inspiratory muscle strength and one outcome of exercise tolerance for individuals with COPD.

**CRD commentary**

This review addressed a clear question. Inclusion and exclusion criteria were clear. Search details were not reported, but represented an update of a previous review. The search was limited to English-language papers and unpublished studies were not sought, so the review was at risk of language and publication biases. Adequate details of the included studies were presented. Appropriate methods to minimise errors and bias were applied to study selection and data extraction; it was unclear whether the same approach was used for the assessment of study quality. Study validity was assessed using appropriate criteria; no composite score was presented, but each criterion was reported upon. Most studies comprised small sample sizes. Results were pooled using meta-analysis. Heterogeneity was reportedly assessed, but the method was not reported.

The authors’ cautious conclusions reflected the evidence, but the variable quality of this evidence and the small sample sizes and uncertain study variability should be borne in mind.

**Implications of the review for practice and research**

**Practice:** The authors did not state any implications for practice.

**Research:** The authors stated that further trials were required to assess the effect of inspiratory muscle training or combined inspiratory muscle training with additional rehabilitation interventions that did not include inspiratory muscle training for a number of outcomes. Studies should aim to determine optimal frequency, intensity and time of inspiratory muscle training to maximise outcomes for COPD patients and identify which patient subgroups may benefit most from the intervention.

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